[0019] In a third aspect of the invention, the proximity-based mutually capacitance-sensitive touchpad operates with a sleep mode and an active mode to thereby conserve power, and prevent undesired touchpad operation when the keys are in use.

[0020] In a fourth aspect of the invention, the electrode grid is comprised of an etched copper on foil Capton GlideSensor.

[0021] In a fifth aspect of the invention, the proximity-based mutually capacitance-sensitive touchpad provides tap, double-tap, scroll control, and cursor control.

[0022] In a sixth aspect of the invention, the touchpad is not affected by the changing distance between the pointing object and the touchpad, enabling the pointing object to travel over keys and between keys without affecting touchpad performance.

[0023] In a seventh aspect of the invention, a separate touchpad is disposed along a side edge of the mobile telephone to provide dedicated scrolling capabilities.

[0024] These and other objects, features, advantages and alternative aspects of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description taken in combination with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

[0025] **FIG. 1** is a perspective view of a typical mobile telephone, having the present invention disposed therein.

[0026] **FIG. 2** is a close-up, expanded, profile and cross-sectional view of a portion of the keypad.

[0027] **FIG. 3** is a close-up profile cross-sectional view of a portion of the keypad.

[0028] **FIG. 4** is an illustration of the prior art that shows that an X electrode grid separated from a Y electrode grid by some dielectric insulating material.

[0029] **FIG. 5** is a cross-sectional profile view of the touchpad that is made in accordance with the presently preferred embodiment.

[0030] **FIG. 6** shows a top view of the Y electrode grids described in **FIG. 5**.

[0031] **FIG. 7** shows a top view of the X electrode grid described in **FIG. 5**.

[0032] **FIG. 8** illustrates the look of the touchpad after all of the overlapping electrode layers are disposed on the touchpad substrate.

[0033] **FIG. 9** is an illustration of a different physical configuration of a mobile telephone.

[0034] **FIG. 10** is an illustration of the mobile telephone of **FIG. 9** with the cover closed.

[0035] **FIG. 11** is a block diagram of the basic components of the mobile telephone.

DETAILED DESCRIPTION

[0036] Reference will now be made to the drawings in which the various elements of the present invention will be given numerical designations and in which the invention will be discussed so as to enable one skilled in the art to make and use the invention. It is to be understood that the following description is only exemplary of the principles of the present invention, and should not be viewed as narrowing the claims which follow.

[0037] The presently preferred embodiment of the invention is a proximity-based mutually capacitance-sensitive touchpad that is disposed directly beneath a keypad keymat of a mobile telephone. Keypad posts associated with each key pass through an electrode grid of the touchpad in such a way so that the posts do not interfere with touchpad detection and tracking of a pointing object that moves along the keypad surface. The keys of the keypad provide the first type of user input. The touchpad is capable of providing data entry, cursor control, and scroll bar control on a display of the mobile telephone. Thus, the touchpad provides the second type of user input. The keys of keypad provide discrete input in the form of alphanumerical characters. In contrast, the touchpad is an impedance sensing means. More specifically, the touchpad utilizes mutual capacitance-sensing technology to determine the location of a finger over a surface thereof.

[0038] **FIG. 1** is a perspective view of a typical mobile telephone **10**. The dotted line **12** indicates the approximate location of the touchpad that is disposed underneath a plurality of keys **20**. The plurality of keys **20** are the only visible portion of a keymat **22** (not shown) disposed underneath a hard housing **14**. The keymat **22** is the first layer of a keypad **18**. The keypad **18** includes all of the components that enable the plurality of keys **20** to actuate corresponding mechanical switches, and in this invention, also includes the touchpad which is integrally disposed therein. The mobile telephone includes a display screen **8**, and may also include some external antenna (not shown). Inside the mobile telephone is disposed a power source such as a rechargeable battery, and the electronic circuitry for the telephone and for the touchpad.

[0039] **FIG. 2** is a close-up and expanded profile and cross-sectional view of a portion of the keypad **18**. This view shows a single key of the plurality of keys **20** that are part of the keymat **22**. The key **20** is typically a rubber-like material which is able to deform. However, the key **20** can also be formed of a rigid material. What is important is that the material used for the key **20** does not interfere with the operation of the touchpad. In other words, the key **20** should not interfere with the detection of mutual capacitance between electrode grids of the touchpad, and the modification of the mutual capacitance caused by a pointing object such as a finger.

[0040] The key **20** includes a post **24** that is utilized to actuate a mechanical switch **32** when the key is pressed.

[0041] The key **20** can be any desired shape. What is notable is that the key **20** is typically a raised shape so that the key protrudes outwards through and slightly above the hard housing **14**. Alternatively, the key **20** can be flush with the surface of the hard housing **14** but this configuration is probably avoided to provide better feedback to the user. Another alternative would be to have the keymat **22** exposed, without any surface of the hard housing to cover it.

[0042] Actuation of the mechanical switch **32** is accomplished when the post **24** presses down on a dome structure